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NATIONAL BUREAU OF STANDARDS REPORT

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FINAL REPORT ON

DUSTING OF ACOUSTICAL MATERIALS

by

Howard T. Arni

NBS

U.S. DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

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1. INTRODUCTION

This project was done under the Tri-Service Engineering Investigations of Building Construction and Equipment at the National Bureau of Standards. The purpose of the project was to investigate and evaluate methods of testing the dusting and adhesion characteristics of acoustical materials.

2. PHASE I

In the first phase of this investigation, the test frame designed and built by Tectum Corporation and described in Guide Specification CE-219.01, 15 December 1961, was acquired on loan from the National Gypsum Company and a duplicate of this frame was built in the NBS shops.

Samples of some sprayed-on acoustical materials were acquired and were subjected to tests in this frame. Also, small samples of the same materials were tested in commercial Ro-Tap machines which were already available in the NBS miscellaneous testing laboratory, according to a procedure described in brochures of the Armstrong Cork Company concerning the product, "Limpet".

Descriptions of the features of these two test procedures follow and data obtained from this series of tests appear in Tables I and II.

2.1 Description of Dusting Frame and Tests

This frame is constructed of angle iron, is supported on four springs, and holds a test specimen approximately 33 x 39 inches. It is vibrated in a vertical direction, at the rate of 3,600 vibrations per minute, by a Syntron Vibrator mounted above the center of the frame. The directions state that the amplitude of vibration shall be 0.005 ±0.001 inch and shall be measured by a dial gage. Considerable difficulty was encountered, first, in devising a method of measuring the amplitude. A method of using two dial gages, one above and one below, and taking readings, both with the frame at rest and vibrating, was

finally devised, but it was never found possible to achieve uniform amplitude of vibration at different points on the frame. Weights had to be clamped to the frame at various points to achieve a total weight of test frame, vibrator, and specimen of 275 ±10 pounds. The character, placement, and manner of placing these weights affected the vibration. During a test, a sheet of Kraft paper was suspended under the frame to collect dusted-off material. The dust collected during a 30-minute preliminary period of vibration was discarded, and that collected during the remaining 23 hours, 30 minutes, of a total 24-hour vibrating time was collected and weighed.

2.2 Description of Ro-Tap Tests

The Ro-Tap is a commercial device in use in soil laboratories for sieving samples of soils and aggregates. A stack of 8-inch sieves is inserted in the device and is subjected to a rotary-reciprocal motion in the horizontal direction and also to vertical shocks caused by a weight being alternately raised and dropped on to the top of the frame over the stack of sieves. In some preliminary tests, square specimens were clamped on top of the top sieve. This proved unsatisfactory, however, and in all the tests reported, the sample was cut to an 8-inch circle that fitted snugly inside the top sieve. Tests were also run with and without the tapping mechanism engaged. Two different machines were used but no significant difference was detected between data obtained from the two machines. Ro-Tap tests were run for one hour and material dusted off during the first five minutes was discarded.

2.3 Results of Phase I

Tests on the two materials used in this phase indicated that there was a wide scatter in individual results from supposedly identical specimens. Problems with obtaining adequate and adequately-mounted specimens were encountered and problems with operation of the large frame, mentioned above, caused troubles. In some cases, notably the Pyrospray specimens in Table I, large masses of the material sloughed off. There were uncertainties as to how much "testing" the samples had already been subjected to when received, and handling the specimens and inserting them in the machines caused damage in some cases.

3. PHASE II

As a result of the problems encountered in Phase I, it was decided that a better approach would be to obtain samples of various prepared boards, panels, and tiles, and subject these to tests in both devices. The amount of dusting obtained from these materials, it was felt, might serve to establish a criterion which sprayed-on materials could be required to meet in the same test. Results of tests on various materials for the vibrating frame and the Ro-Tap machine are given in Tables III and IV, respectively.

For the vibrating frame, mounting problems arose. Samples which were too small to span the machine, such as 1 ft x 1 ft or 2 ft x 2 ft tiles, were mounted by cementing them to a gypsum board backing.

With these materials, there were still large differences between supposedly identical specimens.

4. PROBLEMS

Problems with the approach to evaluation of dusting characteristics fell into three main categories: (1) problems with the test devices themselves and the mounting of the specimens therein; (2) problems with obtaining adequate samples; and (3) problems connected with the question of how well-prepared samples relate to the performance of the materials being tested in any particular installation in which they might be used.

4.1 Problems with Test Devices

1. A number of these, especially with the vibrating frame, have already been mentioned under Phase I above. The problem of obtaining uniform vibration of the test frame within the tolerance prescribed by Guide Specification CE-219.01 never was adequately solved and is probably insoluble. A compromise of measuring the amplitude at a spot near one corner of the frame was adopted in these tests. Also, it is certain that this is a problem which would have to be faced anew for each new specimen, since they differ in weight, thickness, and stiffness.

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2. The Ro-Tap machine appears to provide a more reproducible test than the vibrating test frame, but its value is limited by the small size of the specimen tested. Also, the specimen had to be sawed on a band saw to an 8-inch circle and fitted into the sieve, and this operation itself subjected the specimens to a considerable amount of vibration before they ever were tested.

4.2 Problems with Obtaining Adequate Samples

1. The samples were obtained from various suppliers, prepared by them according to their own techniques, and shipped to the NBS from various distances and by various means. This subjected them to varying amounts of vibration and handling before test.

2. It would be better if it were possible to obtain the materials and prepare the samples in the testing laboratory. This presents great difficulties, however, because of the wide variations in the character of the materials and their method of application. The sprayed-on materials, in general, have their own special application devices and need specially-trained personnel for application. Some of these devices use a slurry of the material premixed in a tub, and in others the solid and liquid materials are mixed directly in the applying gun and sprayed by compressed air. On the job, it is often necessary to spray a number of trial panels in order to adjust the gun before starting the job.

4.2 Relation of Test Specimens to Job Use

1. Sprayed-on acoustical materials are applied to many different kinds of surfaces in practice. In a warehouse, for example, they may be sprayed directly on structural steel, corrugated steel, concrete surfaces, and exposed pipes. Use of samples sprayed on a backing such as a piece of gypsum board would have little value in predicting performance in such installations.

2. The amount and kinds of shocks and vibrations to which buildings are subjected in various situations are not known and are difficult to evaluate, and the responses of different

buildings to the same vibrational environment differ. Thus, it is difficult, if not impossible, to duplicate in a test method the kind of shock and vibration to which the material will be subjected in service.

3. As mentioned above, applicators and applying personnel differ.

In general, it appears that satisfactory performance of a test panel in any test that could be devised is no guarantee that the material would perform satisfactorily in any given future installation, and failure in such a test would not indicate that the material could not be applied satisfactorily and give satisfactory performance on a job.

5. RECOMMENDATIONS

1. In view of all the above problems, it is recommended that the approach of trying to set up a test method to be used on small sprayed-on specimens be abandoned.

2. For prepared materials such as those used in Phase II, a test method for small samples may be adequate, though here too there are wide differences in installation techniques and in adequacy of installation.

3. The Ro-Tap appears to be a better device for the latter purpose because of the problems of non-uniform vibration and of specimen mounting with the vibrating test frame.

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TABLE I

Tests of Sprayed-on Acoustical Materials on Large Vibrating Frame

Material	Amount of Dust in 23 1/2 hrs, g Total	per sq ft
Cafco Soundshield, "85", #1	0.2231	0.0298
Cafco Soundshield, "85", #2	0.0955	0.0127
Cafco Powershield, #1	0.1501	0.0200
Cafco Powershield, #2	0.0841	0.0112
Cafco Soundshield, #1	0.2150	0.0287
Cafco Soundshield, #2	0.1321	0.0176
Cafco Heatshield, #1	0.1741	0.0232
Cafco Heatshield, #2	0.0310	0.0414
Cafco Type D, #1	0.1620	0.0216
Cafco Type D, #2	0.1065	0.0142
Cafco Blazeshield, #1	0.0745	0.0099
Cafco Blazeshield, #2	Specimen damaged.	
BEH Pyrospray, #1	190.0	25.4
BEH Pyrospray, #2	35.2	4.70

TABLE II

Tests of Sprayed-on Acoustical Materials on Ro-Tap Machine

Material	Total Amount of Dust in 55 min., g.			
	With Tap		Without Tap	
	Machine #1	Machine #2	Machine #1	Machine #2
Cafco Soundshield	0.0821	0.0445	0.0339	0.0039
	0.0739	0.0265	0.0052	0.0249
	0.0545	0.0306	0.0290	0.0675
BEH Pyrospray	0.0213		0.0077	
	0.0217		0.0070	

TABLE III

Tests of Tiles and Panels on Large Vibrating Frame

Material	Manufacturer	Amount of Dust in 23 1/2 hrs, g. Total	per sq ft
Gold Bond Fire-Shield solitude panel with gypsum topping	National Gypsum Co.	0.0127 0.2177	0.0016 0.0290
Same without gypsum topping	same	0.0812 1.7656 0.3012	0.0107 0.2356 0.0401
Water fetted mineral wool without gypsum topping	U.S. Gypsum Co.	0.0497 0.0300	0.0066 0.0040
Travertine ceiling panels without gypsum topping	Gustin-Bacon Manufacturing Co.	0.0040 0.0442	0.0005 0.0059
Pin-perforated panels, 2'x4', painted both sides with vinyl	Owens-Corning Fiberglas	0.0157 0.0184	0.0021 0.0025
Acoustone, foil-backed, 1'x1' tiles, starch bound mineral wool (glued to gypsum board backing)	U.S. Gypsum Co.	0.1107 0.0209	0.0147 0.0028
Styletone, fissured mineral tile, 1'x1'	Baldwin-Ehret Hill, Inc.	0.1147 0.0082	0.0153 0.0011
Acousti-Shell flat panel, fiber glass acoustical tile	Johns-Manville	0.0172 0.0067	0.0023 0.0009
Fissured tile, 2'x2'	National Gypsum Co.	0.0537 0.1067	0.0072 0.0142
Spintone acoustical panels, 2'x2'x5/8", 1161 pierced pattern	Johns-Manville	0.0394 0.0730	0.0053 0.0097
Tectum, 4'x4'x2", backed with building paper	National Gypsum Co.	0.1498 1.4719	0.0200 0.1967

TABLE IV

Tests of Tiles and Panels on Ro-Tap Machine

Material	Manufacturer	Total Amount of Dust in 55 min., g. With Tap	Without Tap
Gold Bond solitude acoustical tile, needlepoint design	National Gypsum Co.	0.0130 0.0340	0.0100 0.0055
Acoustone incombustible tile, foil-backed, starch bound, mineral wool, fissured pattern	U.S. Gypsum Co.	0.0170 0.0201	0.0330 0.0601
Styletone non-combustible mineral tile, fissured	Baldwin-Ehret Hill, Inc.	0.0095	0.0070
Travertine ceiling panel	Gustin-Bacon Manufacturing Co.	0.0045	0.0005
Gold Bond Fire-Shield solitude panels	National Gypsum Co.	0.0316	0.0130
Water (wet) fetted mineral wool ceiling panels, fissured and needlepoint	U.S. Gypsum Co.	0.0205	0.0050
Acousti-Shell flat panels, 2'x2'	Johns-Manville	0.0021	0.0000
Tile, 2'x2'	National Gypsum Co.	0.0080	0.0017
Spintone acoustical panels, 2'x2'	Johns-Manville	0.0053	0.0020
Film-faced textured tile	Owens-Corning Fiberglas	0.0033 0	0.0025
Frescor tile, 5/8"	Owens-Corning Fiberglas	0.0228	0.0123
Tectum, 2" backed with building paper	National Gypsum Co.	0.0545	0.0080
Tectum, 1" without backing	National Gypsum Co.	0.0704	0.0237
Pin-perforated panels, 2'x4', painted both sides	Owens-Corning Fiberglas	0.0172	0.0037
Sanofaced, 2'x4'	Owens-Corning Fiberglas	0.0178	0.0030

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